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Address delivered by the President (Sir J. F. W. Herschel, Bart.) on presenting the Honorary Medal of the Society to William Lassell, Esq., of Liverpool.

Gentlemen,—The Report of the Council having been read, in which the astronomical discoveries of the year, and especially that of the planet *Metis*, have been clearly and eloquently commemorated, it is now my pleasing duty to state to you the grounds on which it has been agreed by us to award the gold medal of the Society for this year to Mr. Lassell. And this duty, pleasing in itself, I execute with the greater satisfaction, because I have a sort of hereditary fellow-feeling with Mr. Lassell, seeing that he belongs to that class of observers who have created their own instrumental means—who have felt their own wants, and supplied them in their own way. I believe that this greatly enhances the pleasure of observing, especially when accompanied by discovery, and gives a double interest in the observer's eyes, and perhaps, too, in some degree, an increased one in those of the public, to every accession to the stock of our knowledge which his instruments have been the means of revealing: upon the same principle that the fruit which a man grows in his own garden, cultivated with his own hands, is enjoyed with a far higher zest than what he purchases in the market. Nor is this feeling by any means a selfish one. It arises from the natural and healthy excitement of successful exertion, and is part of that happy system of compensation by which Providence sweetens effort, and honours well-directed labour. If this be true of the labour of a man's hands in the mere production of material and perishable objects, it is so in a far superior sense, when the faculties of the intellect are called into exercise, and works elaborated with rare skill, and wrought to an extraordinary pitch of perfection, have yet a higher, ulterior, intellectual object, to which their existence is subordinate, as means to an end.

Mr. Lassell has long been advantageously known to us as an ardent lover of astronomy, and as a diligent and exact observer, in which capacity he has appeared before us, as a reference to our *Memoirs* and *Notices* will testify, on numerous other occasions besides those to which I shall more particularly call your attention presently. In the year 1840 he erected an observatory at his residence near Liverpool, bearing the appropriate name of Starfield, which has ever since been the scene of his astronomical labours. Even at its first erection this observatory presented features of novelty and interest. In addition to a good transit it was furnished, instead of a meridian instrument or an ordinary equatorial achromatic, with a Newtonian reflecting telescope of 9 inches aperture, and rather more than 9 feet in focal length, equatorially mounted, the specula of which were of his own construction, and the mode of mounting devised by himself. This was already a considerable step, and forms an epoch in the history of the astronomical use of the reflecting telescope. Those only who have had experience of the annoyance of having to keep an object long in view, especially under high magnifying powers, and in micrometrical measurements, with a reflector mounted in the usual manner, having merely an altitude and azimuth motion, can duly feel and appreciate the advantage thus gained. But the difficulties to be surmounted in the execution of such a mode of mounting were very considerable—much more so than in the case of an achromatic,—owing partly to the non-coincidence of the centre of gravity of the telescope and mirror with the middle of the length of the tube, and partly to the necessity of supporting the mirror itself within the tube in a uniform bearing free from lateral constraint, and guaranteed against flexure and disturbance of its adjustment by alteration of its bearings. These difficulties, however, Mr. Lassell overcame: the latter, which is the most formidable, by an ingenious adaptation of the balancing principle first devised, if I am not mistaken, by Fraunhofer and Reichenbach for the prevention of flexure in the tubes of telescopes —a principle which has not received half the applications of which it is susceptible, and which, by throwing the whole strain of the weight of instruments on axes which may be made of unlimited strength, may be employed to destroy the distorting force of gravity on every other part.*

The success of this experiment was such, and the instrument was found to work so well, that Mr. Lassell conceived the bold idea of constructing a reflector of 2 feet in aperture and 20 feet in focal length, and mounting it upon the same principle. The circumstances of his local situation, in the centre of manufacturing industry and mechanical construction, were eminently favourable to the success of this undertaking; and in Mr. Nasmyth he was fortunate enough to find a mechanist capable of executing in the highest perfection all his conceptions, and prepared, by his own love of astronomy and practical acquaintance with astronomical observation and with the construction of specula, to give them their full effect. It was of course, however, the construction and polishing of the large reflector which constituted the chief difficulty of this enterprise. To ensure success, Mr. Lassell spared neither pains nor cost. As a preliminary step, he informs us that he visited the Earl of Rosse, at Birr Castle, and besides being favoured with more than one opportunity of satisfying himself of the excellent performance of that nobleman's 3-foot telescope, enjoyed the high privilege of examining the whole machinery for grinding and polishing the large speculum, and returned so well satisfied as to resolve on the immediate execution of his own ideas.

The mode of casting and grinding the mirror, differing in some

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* As, for example, the divided limbs of circles, and the spokes connecting them with their centres; an easy and simple mechanism, which, devised some time ago, and approved by the late M. Bessel, I may, perhaps, take some future opportunity to submit to the Society.—(*Note added in the Printing*).

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of the details, though proceeding generally on the same principle as Lord Rosse's (*i. e.* by a chilled casting), has been described in a communication read to this Society on the 8th of December last. The polishing was performed on a machine almost precisely similar to that of his lordship. But finding after many months' trial that he could not succeed in obtaining a satisfactory figure, he was led to contrive a machine for imitating as closely as possible those evolutions of the hand by which he had been accustomed to produce perfect surfaces on smaller specula. This machine has been described (and a model of it, as well as Mr. Nasmyth's finished working drawings of it, exhibited) in the paper to which I have already referred, of which an abstract has been printed in our *Notices*, and must by this time be in the hands of every fellow here present, so that it cannot be necessary for me to recapitulate its contents. Suffice it to say that I have carefully examined both the drawings and the model, and having myself had some experience in the working and polishing of reflecting specula, approaching (though inferior) in magnitude to Mr. Lassell's, I am enabled to say that the machine seems to unite every requisite for obtaining a perfect command over the figure; and when executed with that finish which belongs to every work of Mr. Nasmyth, from the steam-hammer down to the most delicate product of engineering and mechanical skill, cannot fail to secure, by the oily smoothness and equability of its movements, the ultimate perfection of polish, and the most complete absence of local irregularities of surface. The only part which I do not quite like about it, or perhaps I should rather say which seems open to an *à priori* objection, refutable, and, in point of fact, refuted by the practical results of its operation, is the wooden polisher, owing to the possibility of warping should moisture penetrate the coating of pitch with which it is (I presume) enveloped on every side. Some unhygrometric, non-metallic substance, such as for instance earthenware, porcelain biscuit, or slate, would be free from this objection, though possibly open to others of more importance.

Both Mr. Lassell and Lord Rosse appear to be fully aware of the vital importance of supporting the metal, not only while in use, but also during the process of polishing, in a perfectly free and equable manner; but the former has adopted a mode of securing a free bearing on the supports, by suspending the mirror, which is a great and manifest improvement on the old practice of allowing it to rest on its lower edge, by which not only is the figure necessarily injured by direct pressure, but the metal is prevented from playing freely to and fro, and taking a fair bearing on its bed. As I have, however, on another occasion enlarged on the necessity of making provision against these evils, by a mechanism almost identical in principle, I need not dwell upon this point further than to recommend it to the particular attention of all who may engage in similar undertakings.

It is right that I should now say something of the performance of the 9-inch and 2-feet reflectors. And first, as regards the suc-

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cess of the system of mounting adopted in securing the peculiar advantages of the equatorial movement. This appears to have been very complete. The measurements, both differential and micrometrical, made with them, and recorded in our *Notices*, shew that in this respect they may be considered on a par with refractors, and in facility of setting and handling they appear no wise inferior. Of the optical power of the former instrument, two facts will enable the meeting to form a sufficient judgment. With this Mr. Lassell, independently and without previous knowledge of its existence, detected the sixth star of the trapezium of *θ Orionis*. And with this, under a magnifying power of 450, and in very unfavourable circumstances of altitude, both himself and Mr. Dawes became satisfied of the division of the exterior ring of *Saturn* into two distinct annuli, a perfectly clear and satisfactory view of the division being obtained.

The feats performed by the larger instrument have been much more remarkable and important. It has established the existence of at least one of the four satellites of *Uranus*, which since their announcement by Sir W. Herschel had been seen by no other observer, viz. the innermost of all the series, and afforded strong presumptive evidence of the reality of another, intermediate between the most conspicuous ones. The observations of M. Otto Struve, if they really refer to the same satellite, are of nearly a month later date.

To Mr. Lassell's observations with this telescope we also owe the discovery of a satellite of *Neptune*. The first occasion on which this body was seen was on the 10th of October, 1846, but owing to the then rapid approach of the planet to the end of its visibility for the season, it could not be satisfactorily followed, until the next year, when, on the 8th and 9th of July, observations decisive as to its reality as a satellite were made, and in August and September full confirmation was obtained. This important discovery has since been verified both in Russia and in America. I call it so, because, in fact, the mass of *Neptune* is a point of such moment, that it is difficult to overrate the value of any means of definitively settling it. Unfortunately, the exact measurement of the satellite's distance from the planet is of such extreme difficulty, that, up to the present time, astronomers are still considerably at issue as to the result.

I come now to the most remarkable of Mr. Lassell's discoveries, one of the most remarkable, indeed, as an insulated fact, which has occurred in modern astronomy; though, indeed, it can hardly be regarded as an insulated fact, when considered in all its relations. I need hardly say that I allude to the discovery of an eighth satellite of *Saturn;* a discovery the history of which is in the highest degree creditable, not only to the increased power of the instruments with which observatories are furnished in these latter days of astronomy, but also to the vigilance of observers. If I am right in the principle that discovery consists in the certain knowledge of a new fact or a new truth, a knowledge grounded on positive and tangible evidence, as distinct from bare *suspicion* or *surmise* that such a fact exists, or that such a proposition is true—if I am right in assigning as the moment of discovery, that moment when the disco-

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verer is first enabled to say to himself, or to a bystander, " I *am sure* that such is the fact,—and I am sure of it, *for such and such reasons*," reasons subsequently acquiesced in as valid ones when the discovery comes to be known and acknowledged—if, I say, I am right in this principle (and I really can find no better), then I think the discovery of this satellite must be considered to date from the 19th of September last, and to have been made simultaneously, putting difference of longitude out of the question, on both sides of the Atlantic. In speaking thus, I desire, of course, to be understood as expressing only my own private opinion, and in no way as backing that opinion by the authority of the Society whose chair I for the moment occupy. The Astronomical Society receives with equal joy the intelligence of advances made in that science from whatever quarter emanating, and accords the meed of its approbation to diligence, devotion, and talent, with equal readiness wherever it finds them—but declines entering into *nice* questions of personal or national priority, and would, I am sure, emphatically disavow the assumption of any title to lay down authoritative rules for the guidance of men's judgments in such matters. The medal of this day is awarded to Mr. Lassell, not on account of this discovery alone, and as such, but as taken in conjunction with the many other striking proofs he has afforded of successful devotion to our science—both in the improvement and in the use of instruments. And among the motives which have induced your Council to place Professor Bond on the list of our Associates (I trust not long to be the only one of his countrymen by whom that honour is enjoyed), though this discovery has had its due and just weight, we have not been unheedful of his general merits, both as an observer and as a theoretical astronomer—merits of which the *Memoirs* which have recently reached us convey the most abundant evidence in both departments.

I have observed that, when taken in all its relations, the discovery of an eighth satellite of *Saturn* cannot be regarded as quite an insulated fact. Between *Iapetus* and *Titan* there existed a great gap unfilled, in which (as formerly between *Mars* and *Jupiter*) it was not in itself unlikely that some additional member of the Saturnian system might exist. The extreme minuteness of *Hyperion* forcibly recalls the analogous features of the asteroids, and it would be very far from surprising if a further application of the same instrumental powers should carry out this analogy in a plurality of such minute attendants.

Mr. Lassell, as you are all well aware, is bound to astronomy by no other tie than the enjoyment he receives in its pursuit. But in *our* estimation of his position as an Amateur Astronomer it must not be left out of consideration, that his worldly avocations are such as most men consider of an engrossing nature, and which entitle them in their moments of relaxation, as they conceive, to enjoyments of a very different kind from those which call into fresh and energetic exertion all their faculties, intellectual and corporeal. It is no slight and desultory exercise of those faculties which will enable any man to carry into effect so much thoughtful combination, and to avail himself with so much consecutiveness of their

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results when produced. And however we may and must acknowledge that such a course of action is really calculated to confer a very high degree of enjoyment and happiness, we ought not to feel the less gratefully towards those who, by their personal example, press forward the advent of that higher phase of civilisation which some fancy they see not indistinctly dawning around them; a civilisation founded on the general and practical recognition of the superiority of the pleasures of mind over those of sense; a civilisation which may dispense with luxury and splendour, but not with the continual and rapid progress of knowledge in science and excellence in art.

I think I should hardly be doing full justice to my subject or to the grounds taken by the Council in the award, if I were to conclude what I have to say otherwise than in the pointed and emphatic words of a Report officially embodying the prominent features of the case. "The simple facts," says that document, "are, that Mr. Lassell cast his own mirror, polished it by machinery of his own contrivance, mounted it equatorially in his own fashion, and placed it in an observatory of his own engineering: that with this instrument he discovered the satellite of *Neptune*, the eighth satellite of *Saturn*, and re-observed the satellites of *Uranus*. A private man, of no large means, in a bad climate" (nothing, I understand, can be much worse), "and with little leisure, he has anticipated, or rivalled, by the work of his own hands, the contrivance of his own brain and the outlay of his own pocket, the magnificent refractors with which the Emperor of Russia and the citizens of Boston have endowed the observatories of Pulkowa and the Western Cambridge."

(*The President then, delivering the Medal to Mr. Lassell, addressed him in the following terms*):—

And now, Mr. Lassell, all that remains for me is to place the medal in your hands, and to congratulate you on your success and on the noble prospect of future discovery which lies before you, now that, free from the preliminary labour of construction, your whole attention can be devoted to using the powerful means you have created. In the examination of the nebulæ, in the measurement of the closest double stars, and the discovery of others which have hitherto defied separation—in the physical examination of the planets and comets of our own system, there is a wide field open and the sure promise of an ample harvest; and I can only add, that we all heartily wish you health and long life to reap it.

The Rev. W. Read, M. A., Summer Place, Broughton, Manchester;
Benjamin Bell, Esq., Jesmond Villas, Newcastle-on-Tyne;
Thomas Weddle, Esq., Wimbledon;
Robert Stephenson, Esq., M.P.; and
Thomas Coventry, Esq., 5 Old Sq., Lincoln's Inn,

were balloted for and duly elected Fellows of the Society.